Title: Sensationalism and speaking to the public: Scientific rigour and interdisciplinary collaborations in paleopathology.

Authors: Anne Marie E. Snoddy*[1], Julia Beaumont[2], Hallie R. Buckley[1], Antony Colombo[3,4], Siân E. Halcrow[1], Rebecca L. Kinaston[1], Melandri Vlok[1].

*corresponding author
University of Otago, Department of Anatomy
270 Great King St.
Dunedin, Otago
New Zealand 9016
annie.sohler@otago.ac.nz
+64 226272143

[1]University of Otago, Department of Anatomy

[2]University of Bradford, School of Archaeological and Forensic Sciences

[3]Chaire d'anthropologie biologique Paul Broca, EPHE-PSL University Paris.

[4]UMR 5199 PACEA, University of Bordeaux, CNRS, MCC ; LabEx Sciences archéologiques de Bordeaux, n°ANR-10-LABX-52, bât. B8, allée Geoffroy Saint Hilaire, CS50023, F-33615 Pessac, France.

Abstract: In this brief communication we discuss issues with scientific rigour in paleopathological publications, particularly studies published in clinical or general science journals which employ skeletal analysis to elucidate the lives and deaths of historical figures or interpret “mysterious” assemblages or burials. Although some of these publications are methodologically sound and well interpreted, others have suffered from poor scientific rigour stemming from an apparent lack of awareness of anthropological methods. When these publications are highlighted by the press, sensationalistic narratives are perpetuated which reflect poorly on our discipline and give the public unrealistic expectations about our work. Here we provide examples of some pitfalls to avoid in high-profile interdisciplinary paleopathological research, discuss the importance of communication between paleopathologists and experts from other fields, and suggest ways in which collaborative work between specialists and specialists from other fields can move forward for the benefit of all.

Paleopathology is by its nature interdisciplinary, drawing on clinical pathology, human osteology, epidemiology, social anthropology, and archaeology in an attempt to understand disease in the past. The research of clinical pathologists and epidemiologists, in particular, is vitally important for paleopathological methodological development and study design. Indeed, many of the pioneers of paleopathology began their careers in medicine and health related services (Buikstra and Roberts, 2012). However, anthropological training in the analysis of archaeological human remains and an appreciation for the limitations inherent in paleopathological analysis is equally important for appropriate interpretation of health and disease in the past. Consideration of the wide spectrum of skeletal lesion manifestation, an appreciation for taphonomic changes to bone and how these may affect diagnosis, and an understanding of the very limited and often ambiguous ways in which bone responds to disease are necessary (Schotsmans et al. 2017; Caffel et al. 2001; Dutour, 2011; Ortner, 2003). It is also well understood in paleopathology that the majority of diseases do not incite an osseous response and in cases of acute disease, lesions may not have time to develop before death (Wood et al., 1992). It is only when we have an appreciation of appropriate methodology, an understanding of the biology of pathological bone changes, and a thorough consideration of the environmental context necessary for identifying the etiology of disease that sound differential diagnoses can occur.

Recently, there has been an increase in the publication of what we consider sensationalised paleopathological studies published in general science and medical journals. These manuscripts are essentially 'biological exposés' of the remains of historical figures or catastrophic skeletal assemblages (e.g. Charlier et al., 2016; Gregersen, 2006; Hawass et al., 2010; Kacki et al., 2018; Ponti et al., 2016). Where such publications are methodologically sound, following accepted paleopathological and anthropological standards, and appropriately interpreted in the historical and archaeological context, they help to advance a meaningful understanding of bioarchaeology in the public sphere (see Appleby et al., 2014, 2015; Belcastro et al., 2011; Kacki et al., 2018). However, some appear to have dismissed or only superficially engaged with established methodological protocols for the identification of disease in skeletal or mummified human remains (Charlier et al., 2016, 2019; Bhattacharya et al., 2018, Loynes et al., 2018). Frequently these manuscripts are authored by scholars with little understanding of the limitations of paleopathology and appear to have gone through peer review without input from paleopathologists or archaeologists. In these cases, the end-product is one in which results are interpreted to fit a desired narrative (see Halcrow et al. 2018), often at the expense of scientific rigour. In this brief communication, we highlight some of the problems common to such publications, highlight the importance of communicating the limitations of our research to the press and public, and discuss ways in which fruitful collaboration between paleopathologists and other specialists can be fostered.

1.1 Public engagement: the consequences of poor methodological rigour and sensational interpretations.

Some degree of media spin is inevitable in high profile research (section 1.2). However, if study being presented to the public already suffers from methodological and interpretive issues, sensational narratives are further exaggerated. Some of these problems include disregard or unfamiliarity for the limited ways in which disease responds to bone, taphonomy, no differential diagnosis, and poor engagement with ethnography and archaeological theory, all of which feed confirmation bias. A recent publication in a clinical

journal on a mandible purported to belong to Louis IX of France highlights many of these problems (Charlier et al., 2019). Media coverage[1][2][3] of this paper perpetuated the story that King Louis died of scurvy because he refused to eat local foods during the 8th crusade - despite the fact that the provenance of the mandible was unproven, the lesions exhibited by it are non-specific, and historical evidence does not support this hypothesis. Likewise, unfamiliarity with basic developmental osteology, archaeological ethics, and aDNA analysis led to the recent publication of a truly disastrous interpretation of pathology in the "Ata mummy" in *Genome Research* (Bhattacharya et al., 2018; c.f. Halcrow et al., 2018).

A particular illustrative example of sensationalist headlines and media frenzy leading from bioarchaeological work has been pointed out by Kristina Killgrove with the "gay caveman", "Hasanlu Lovers" and the "gay lovers" from Pompeii stories (Killgrove, 2017). She argues although the media and public interest could be seen as a positive way to highlight non-heteronormative interpretations of the past, that they are problematic as the context and nuance are lost in these popular representations of bioarchaeological research (Killgrove 2017, 2018). Killgrove (2018) states that we "*need to remember that contemporary terms cannot necessarily be used in the same way, and that faulty and biased modern assumptions can pervade our interpretations of the past if we are not careful*."

This lack of methodological rigour is more than unscientific: it has real world consequences for the ability of bioarchaeologists to operate in the field and laboratory. These publications, and their resulting press coverage, perpetuate a sort of paleopathological "CSI effect" wherein members of the public, including descendant communities, may have unrealistic expectations about the data that we can provide them. This results in frustration on all sides; headache for the anthropologists and heartache for members of the public who are emotionally invested in our research. Some of the unrealistic expectations which have been actively fostered by such publications include "confirmation of identity" of historic figures by face matching skulls to statues (Gregersen et al., 2006; Charlier et al., 2019), purported reconstruction of occupational histories from degenerative joint changes (Capasso and Domenicantonio, 1998; c.f. Jurmain et al., 2012: 535-536), and claimed unequivocal diagnosis of a specific disease from non-specific skeletal lesions (Charlier et al., 2019; Ponti et al., 2016).

This is not to say that work of a high methodological standard is never distorted by the press to push a particular narrative and authors are limited to some extent in the amount of damage control they can do when this occurs. However, there are ways paleopathologists can mitigate some of the misunderstandings associated with general press publicity of their research. Firstly, it may be best to time the press release at the same time of publication after, research has been peer reviewed, or provide an embargoed copy of the paper and summary of facts for other researchers to evaluate the actual study before providing an expert opinion on the findings. In the press release, the findings and their limitations should be clearly stated in general terms. Finally, working with media communicators is useful for understanding how to "pitch" research without compromising the integrity of our findings. It will benefit us as paleopathologists to understand what aspects of research tend to be picked up readily by the media: what the public is going to find engaging in our research,

---

[1] https://www.smithsonianmag.com/smart-news/fear-foreign-food-led-death-crusader-king-180972491/

[2] https://www.dailymail.co.uk/sciencetech/article-7174553/French-Crusader-King-Louis-IX-died-SCURVY-refused-eat-African-cuisine.html

[3] https://www.sciencesetavenir.fr/archeo-paleo/archeologie/la-mort-de-saint-louis-une-affaire-de-scorbut_134602

how may the research be distorted as a negative, and how can we use this to guide readers towards a 'take home message' they will receive from the media outputs (Killgrove, 2018). The goals of media outlets do not necessarily align with those of researchers, and having clear and transparent communication with the media may enable researchers to regain a level of control over the general publicity of their research articles.

1.2 The importance of interdisciplinary communication

The current university and academic publishing climate actively discourages the publication of negative results and scholars in all disciplines are under considerable pressure to produce research that will make a good headline. Although paleopathologists may be more cautious than clinicians in their interpretations of disease in the past, a lack of awareness of best anthropological practices by scholars from other professional spheres can perpetuate a misunderstanding of the level of scientific rigour in our own field. Similarly, the lack of recognition of palaeopathology as a legitimate discipline that uses knowledge from the past to elucidate the potential impact on human society of changing disease dynamics (Roberts, 2016) is endemic. However, this recognition will also only likely change when paleopathologists actively engage with researchers from other related fields in regards to research design and outcomes.

Paleopathologists are not entirely guiltless when it comes to poor cross-disciplinary scholarship. Mays (2012) and others have highlighted the diagnostic and theoretical issues that have arisen from unfamiliarity with current clinical thought on disease pathophysiology and lesion presentation. Palaeopathological methods have sometimes suffered from a kind of circular logic wherein older anthropological literature which is no longer clinically accurate is used as the foundation for entire diagnostic schemes (see Mays, 2012). In the past decade a great deal of progress has been made with leaders in the field advocating for greater engagement with clinical pathophysiology and methodological and descriptive standardization (e.g. Buikstra et al., 2017; Klaus, 2017; Zuckerman et al. 2012). However, in order for this work to move forward we need to actively foster collaborations with clinicians and others who study contemporary human biology. It would be particularly beneficial to involve clinicians with specialties in particular diseases in the development of standardised diagnostic protocol. Engagement with epidemiologists may also provide new perspectives on the modelling of disease dynamics in the past and create bridges where paleopathological information is translatable for use in modern epidemiological models. In this way, we can continue to incorporate current clinical thought into our own methods and models while in turn familiarizing other professionals with anthropological methods so they have realistic expectations regarding the data that can be collected from archaeological remains.

2. Conclusions and suggestions for best practice

Other fields, including medicine, contribute significantly to palaeopathological research. By its nature bioarchaeology lends itself well to collaborative research. In this way we can reduce the possible errors in diagnosis and interpretation by non-specialists in both professional realms. Many paleopathologists seek the expertise of clinicians in their interpretations and similarly clinicians would benefit from a collaborative approach in their palaeopathological research. We summarise some ways in which this can be done below:

- The limitations associated with diagnosing disease in ancient human remains (e.g. lack of patient history, non-specificity of many lesions, problems with taphonomy and skeletal completeness, issues of provenance and chain-of-custody of human remains) must be clearly acknowledged.
- As with clinical case-studies, a clear differential diagnostic process with a firm foundation in extant literature should be demonstrated in any paleopathological publication.
- The above point requires knowledge of previous palaeopathological literature and use of established diagnostic methodologies, where applicable. Similarly, paleopathological methods should be continually reassessed to incorporate evolving clinical knowledge.
- Paleopathologists should continue to seek out and foster collaborations with clinicians and modern human biologists.
- Clinical and general science journals publishing palaeopathological work should actively recruit paleopathologists as reviewers. Paleopathological journals should also seek the expertise of clinical scientists in their peer review processes.
- *All* researchers need to be realistic in their interpretations and careful to communicate the limitations of their research to the press.

We hope that this brief communication will serve to promote quality interdisciplinary publications in paleopathology. An engaging narrative is important for capturing public attention and interest in the history of our species. However, it is also important to employ scientifically rigorous methods and to recognize the limitations of our data to avoid presenting 'just so' stories to an unsuspecting public.

Acknowledgements

The authors would like to thank Prof. Oliver Dutour for his comments on an earlier draft. The authors have no funding to declare.

References

Appleby, J., Mitchell, P.D., Robinson, C., Brough, A., Rutty, G., Harris, R.A., Thompson, D., and Morgan, B. (2014). Case Report The scoliosis of Richard III, last Plantagenet King of England: diagnosis and clinical significance. *The Lancet*, 383(9932), 1944. http://doi.org/10.1016/S0140-6736(14)60762-5

Appleby, J., Rutty, G. N., Hainsworth, S. V., Woosnam-Savage, R. C., Morgan, B., Brough, A., Earp, R.W., Robinson, C., King, T.E., Morris, M., and Buckley, R. (2015). Perimortem trauma in King Richard III: a skeletal analysis. *The Lancet*, 385(9964), 253–259. http://doi.org/10.1016/S0140-6736(14)60804-7

Belcastro, M.G., Todero, A., Fornaciari, G., and Mariotti, V. (2011). Hyperostosis frontalis interna (HFI) and castration: The case of the famous singer Farinelli (1705-1782). *J Anat*, 219(5):632-637

Bhattacharya, S., Li, J., Sockell, A., Kan, M.J., Bava, F.A., Chen, S., Ávila-Arcos, M.C., Ji, X., Smith, E., Asadi, N.B., Lachman, R.S., Lam, H.Y.K, Bustamante, C.D., Butte, A.J., Nolan,

G.P. (2018). Whole-genome sequencing of Atacama skeleton shows novel mutations linked with dysplasia. *Genome Res*, 28(4): 423-431.

Buikstra, J.E., Roberts, C.A. (2012). *The global history of paleopathology*. Oxford, UK: Oxford University Press.

Caffel, A., Roberts, C., Janaway, R., Wilson, A. (2001). Pressures on osteological collections: the importance of damage limitation. *Human remains conservation, retrieval and analysis*. Williamsburg, VA: Archaeopress. pp. 187-197.

Capasso, L., Domenicantonio, L. D. (1998). Work-related syndesmoses on the bones of children who died at Herculaneum. *The Lancet*, 352(9140), 1634–1. http://doi.org/10.1016/S0140-6736(05)61104-X

Charlier, P., Bouchet, F., Weil, R., Bonnet, B. (2016). Schistosomiasis in the mummified viscera of Saint-Louis (1270 AD). *Forensic Sci Med Pathol*, 12(1), 113-114.

Charlier, P., Augias, A., Benmoussa, N., Rainsard, P., Froesch, P., Richardin, P., Froment, A., Bianucci, R., Appenzeller, O., Perciaccante, A., Lippi, D., Prades, L. (2019). The mandible of Saint-Louis (1270 AD): Retrospective diagnosis and circumstances of death. *J Stomatol Oral Maxillofac Surg* (early view) http://doi.org/10.1016/j.jormas.2019.05.007

Dutour, O. (2011). *La Paléopathologie*. Paris: CTHS.

Gregersen, M., Boldsen, J., Bjørn, H., Boel, L.W., Fromholt, P. (2006). Examination and identification of a Danish 17th-century nobleman, Laurids Ebbesen. *Forensic Sci Med Pathol*, 2(1), 51-58.

Halcrow, S. E., Killgrove, K., Schug, G. R., Knapp, M., Huffer, D., Arriaza, B., Jungers, W. Gunter, J. (2018). On engagement with anthropology: A critical evaluation of skeletal and developmental abnormalities in the Atacama preterm baby and issues of forensic and bioarchaeological research ethics. Response to Bhattacharya et al. “Whole-genome sequencing of Atacama skeleton shows novel mutations linked with dysplasia” in Genome Research, 2018, 28_ 423–431. Doi_ 10.1101/gr.223693.117. *Int J Paleopathol*, *22*, 97–100. http://doi.org/10.1016/j.ijpp.2018.06.007

Hawass, Z., Gad, Y. Z., Ismail, S., Khairat, R., Fathalla, D., Hasan, N., Ahmed, A., Elleithy, H., Ball, M., Gaballah, F., Wasef, S., Fateen, M., Amer, H., Gostner, P., Selim, A., Zink, A., Pusch, C.M. (2010). Ancestry and Pathology in King Tutankhamun's Family. *Jama*, 303(7), 638–647. http://doi.org/10.1001/jama.2010.121

Jurmain, R., Alves Cardoso, F., Henderson, C., Villotte, S. (2012). Bioarchaeology’s holy grail: The reconstruction of activity. In: Grauer, A. L., Ed. *A Companion to paleopathology*. Oxford, UK: Wiley-Blackwell. pp. 531-552.

Kacki, S., Velemínský, P., Lynnerup, N., Kaupová, S., Jeanson, A.L., Povýšil, C., Horák, M., Kučera, J., Rasmussen, K.L., Podliska, J., Dragoun, Z. (2018). Rich table but short life:

Diffuse idiopathic skeletal hyperostosis in Danish astronomer Tycho Brahe (1546-1601) and its possible consequences. PloS one, 13(4): e0195920.

Killgrove, K. (2017). Is that skeleton gay? The problem of projecting modern ideas onto the past. Forbes. Viewed 10 October 2019, <https://www.forbes.com/sites/kristinakillgrove/2017/04/08/is-that-skeleton-gay-the-problem-with-projecting-modern-ideas-onto-the-past/#5939288230e7>

Killgrove, K. (2018). Bioarchaeology and the Media: Anthropology Scicomm in a Post-Truth Landscape. In: Buikstra, J.E., Ed. *Bioarchaeologists speak out: Deep time perspectives on contemporary issues*. Cham: Springer International Publishing. pp. 305-324.

Klaus, H. D. (2017). Paleopathological rigor and differential diagnosis: Case studies involving terminology, description, and diagnostic frameworks for scurvy in skeletal remains. *Int J Paleopathol*, 19: 96– 110.

Loynes, R.D., Charlier, P., Perciaccante, A., Gonzalez, M., Begerock, A., Bianucci, R. (2018). Erosive effects of a posterior mediastinal mass in a 18th to early 19th c. Spanish child mummy. *Forensic Sci Med Pathol*, 14(4): 574-578.

Mays, S. (2012). The relationship between paleopathology and the clinical sciences. In: Grauer, A.L., Ed. *A companion to paleopathology*. Oxford, UK: Wiley-Blackwell. pp. 285-309.

Ortner, D. J. (2003). *Identification of pathological conditions in human skeletal remains*. San Diego: Academic Press.

Ponti, G., Pellacani, G., Tomasi, A., Sammaria, G., Manfredini, M. (2016). Skeletal stigmata as keys to access to the composite and ancient Gorlin–Goltz syndrome history: The Egypt, Pompeii and Herculaneum lessons. *Gene*, 589(2), 104–111. http://doi.org/10.1016/j.gene.2016.01.012

Roberts, C.A. (2016). Palaeopathology and its relevance to understanding health and disease today: the impact of the environment on health, past and present. *Anthropological review*, 79(1): 1-16.

Schotsmans, E.M.J, Márquez-Grant, N., Forbes, S.L. (2017). Introduction. In: Schotsmans EMJ, Márquez-Grant, N., Forbes, S.L., Eds. *Taphonomy of Human Remains: Forensic Analysis of the Dead and the Depositional Environment*. Oxford: John Wiley & Sons. pp. 1-8.

Wood, J.W., Milner, G.R., Harpending, H.C., Weiss, K.M. (1992). The osteological paradox. *Curr Anthropol*, 33(4):343-370.

Zuckerman, M.K., Turner, B.L., Armelagos, G.J. (2012). Evolutionary thought in paleopathology and the rise of the biocultural approach. In: Grauer, A.L., Ed. *A Companion to Paleopathology*. Oxford, UK: Wiley-Blackwell. pp. 34-57.